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Graphic organizer for constructivist approach of advanced science concepts: “Magnetorezistence”

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Abstract

Informational burst nowadays staying in unprecedented development of technical applications is a real challenge for science teachers wishing to offer to their younger and younger interested students the opportunity to reach advanced science concepts. It is very hard for national curriculum to cover all knowledge as to be up to date in a historical approach. Students are very interested in finding out all about the gadgets present everywhere but they don't have the patience to wait till advanced concepts are taught. A solution may be a great change in teachers' attitude about teaching as to keep students interested in science. Constructivist approach means elaborating graphic organizers as instruments intended for knowledge construction using primary restyling of information and mental images forming. We present a graphic organizer as a cognitive map/ scheme projected to cover the main targets used in a creative lesson, to encourage metacognition and collaborative relationships between students and between teacher and students.

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1. Introduction

At a first sight we may consider constructivism as a theory included to interpretative paradigm, because it emphasizes the role of the subject in knowledge (direct experience, and own interpretation). Constructivism is based on key words such as: cooperation, collaboration, debate, etc. All of these go to the idea that constructivism theory has to be seen as a balance between the subjective interpretation of the task and the objective understanding of it (Siemens, 2005; Siemens, 2006).

Constructivism brings in the foreground active and interactive learning and its efficiencies emphasizes when the knowledge building is realized with the purpose of assimilation by the others. The others, in this context are like mirrors reflecting what we already know, understand and transmit. This metaphor has to be permanently between the teacher and his student (asymmetric relationship) but also between the student and his teacher (symmetric relationship). Radical constructivism cannot accept knowledge and information transmission or teaching as a fundamental activity in the school. This constructivism incites and invites to dialog in the context offered by the cognitive individual experiences students are taking part in. Pursuant to instruction cannot be considered outside of any objective's communication, it is students' involving by their own observations in knowledge. To this, it must be

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added assimilation and accommodation contented through a good balance by all types and methods group communication. Cognitive constructivism's roots are in Piaget's papers based on cognitive psychology (Piaget, 1975). Compared to the radical one, cognitive constructivism points out that while the reality exists objectively, it doesn't relief by itself, but only if the versant subject manages the processed aquatinted information and if it attain to a mental building by their restyling. This way, the versant subject shows it's knowledge via the way it interprets reality and find out the truth, by mental restyling, all finalizing in the acknowledgement of what it interiorize.

Constructivist learning emphasizes a strong inter-condition between teaching and learning strategy as the teaching one assures the optimal and efficient conditions for students' learning strategies attaining (Fosnot, 2005; Cobb, 2005). This inter-condition is also increased by the constructivist learning approach. In quotidian physics teaching activities is used the collocation „teaching-learning strategy” including the selection and blending contain elements procedure, learning organizing, methods, procedures, teaching materials (all depending of operational instructional objectives), as a way of how students attain proposed objectives.

Constructivist pedagogical intercession approach represents a real student's dialog achieving with the learning task, conducting to students realizing that some objectives attending may be efficiently done through his own involving. Constructivism is in the knowledge theory a heuristic research of the truth, one's interiorized schemes, mental representations allowing perceptions modeling and also a conception of learning.

What constructivist pedagogy requires for high school learning system, in fact didactical models, is students' mental structures setting going, according to knowledge real status. Didactical or scientifically knowledge organizing can and has to consider the real knowledge status, the way they are behaving in a specific task. It also has to and has the hands-down possibility to be explicit, distinctly defined, contextualized, logical and predictive.

2. What are conceptual maps?

Conceptual maps may also be defined as mirrors of the way of thinking and understanding of those who are elaborating them (Oprea, 2009). They are instruments for knowledge's' organizing and representations. Usually they include concepts, inscribed in different shapes cassettes and the relationships between concepts underlined by tracks.

The concept is the cognitive base unit of thinking condensing general characteristics essential for a class of objects and relationships (Salavastru, 2004). Formally conceptual map is a graphic representation consisting of nodes and arrows references. The nodes are corresponding to important concepts of a certain field.

Combining two nodes including arrow's reference is a logical assertion, the logical basic element of the conceptual map.

Conceptual map may also include cross links, representing the relationships between concepts already placed in different parts of the map. Cross links help us to visualize the way one concept from a map's field describes another concept located in a different part of the map (http://tuxcafe.org~judith/collaborer_cmap).

This way we achieve actual materialization of a scheme, of the knowledge a student has about a concept, or a notion or a specified task.

In a conceptual map, the concepts are presented hierarchically beginning with the most general located in the upper part, continuing with the specific ones (less general) on the lower part.

According to Joseph Novak, conceptual maps are presented as visual representation techniques of informational structure describing the way the concepts belong to a certain field are interrelating (Novak, 1990).

The development of those principles are based on David Ausubel's theory according to new concepts' thoroughly learning is based on ideas already existing in student's mind and on the relationships established between these. Ausubel asseverated the most important factor influencing the learning is the cognitive structure of already existing knowledge, consisting of facts, notions, assessments, theories and brute perceptual data, from whom the one is learning may dispose any moment (Ausubel & Robinson, 1981). Student's efficiency during learning activity is tightly connected with what Ausubel named as preparatory cognitive status, referring to “an adequate luggage of knowledge the student is being fixed for at a time as he is able to face to a new, certain task” (Cucos, 2009).

According to Ausubel, learning is such fundamental assimilating process for new acquisition in the context of previous learned knowledge, of already existed cognitive structures.

Ausubel's opinion is that learning is based on over ordered mechanisms involving during new information reception. Such a mechanism is found in the idea of previous progress organizers. The concept "organizers" is used by the author to nominate more complex and deliberate by the teacher ideas ensemble, presented to the student before the assuming (significant) knowledge, for the purpose of the accessibility of new ideas. Ausubel sustains that there are some models on the knowledge are structuring on (Salavastru, 2004).

The organizers works as a bridge between the new material and the previous ideas could relate to and on could back up.

Ausubel specifies that already existed structures reorganizing are essential in his theory looking through new information. By his theory Ausubel strongly confute automatic learning showing that learning type may bring significance if there are established relationships between previous knowledge and the new information, if there is a knowledge handover.

A significant learning has to satisfy three conditions (http://tuxcafe.org~judith/collaborer_cmap):

- The subject for learning has to be conceptually clear presented using examples as to consider the previous student's knowledge.
- Conceptual maps may help to satisfy this condition, by identifying general concepts before the presentation of the specific ones and by assuring the assistance for establishing the relationships between them. The learner has to have previous relevant knowledge.
- The student has to opt in significant learning way. This can be realized indirectly using chosen learning strategies and also using evaluating used strategies. Creativity can be seen as a very high level significant learning.

The new knowledge can't be learned consciously than if in cognitive structure there are ideas these knowledge can be reported to. The new learning makes sense when basic ideas are found to build new crop results in the mind of those who are learning (Oprea, 2009).

An information can be integrated in a conceptual network is better understood and memorized. This integration is dependent of subject's previous knowledge. The role of the previous knowledge makes sense during the process of information processing.

3. Psychological Fundamentals of Conceptual Maps for Constructivist Advanced Physics Learning

As to keep in mind correct information and to call it anytime you want, you have to be connected to something already known at the time. As to the information come into being it has to be part of what we know about that subject. Previous knowledge has to redound as benchmarks allowing contouring the new information. Wegner's research proved that for the students, simply using conceptual maps technique putting over would allow intellectually capacity increasing for many of them (Wegner, 1986; Wegner, 1995).

The teacher has to butts in students' knowledge organizing, to determine student to be conscious about his own cognitive resources, to examine his own learning strategies and to use the most efficient of them (Salavastru, 2004).

In the case of science teaching, proper to physics, some premises are identified:

- During new knowledge acquisition and integration, previous knowledge already existing in the long memory influence new knowledge learning.
- The teacher has to know cognitive processes associated with a certain scientific content will be studied by the student to be certain he can do it.
- Before of task solving the student has to have a large representation of it.
- The tasks advanced to the students has to be problem formulated (problem situation) as much interesting and motivating for them.

During class activities the teacher has to adapt to student's thinking intercession, sometimes activities realized by using conceptual map (Zieneddine & Abd-El-Khalick, 2001; Pankratius, 1990).

During physics lessons images are frequently used for facilitating the understanding and aquatinting of the phenomena by the students (Iofciu & Miron, 2010; Iofciu, Miron & Antohe, 2010). The premises of this study are

that students do not have the competence of analyzing and correct interpretation and its representations so they need to be lead for directly knowledge building by the teacher or indirectly using working precise request tasks.

There is learning contexts build on moderate constructivism, where students build their own knowledge based on images, leaded by teacher's questions and overseen by instant answering evaluation. In the first learning situation, the teacher is asking by questions reality knowledge building shown in the image bellow on four cognitive levels: a) the level of identification of elements by observing; b) the levels of analyzing of identified elements; c) the level of understanding (interpretation) of the meaning of the elements; d) the level of application. The teacher submits students at another high level cognitive working task, the synthesis, when he suggests a conceptual map (fig. 1).

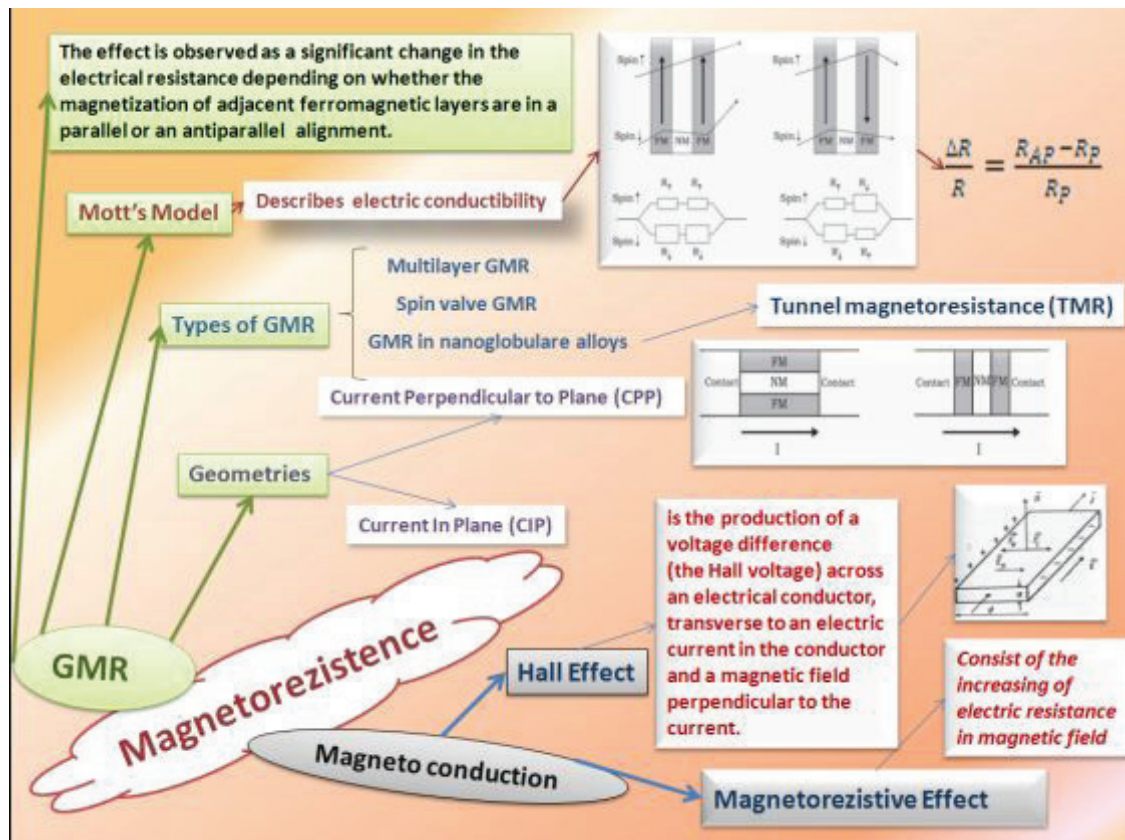


Figure 1. Graphic organizer as a conceptual map for constructivist approach for "Magnetoresistance"

We illustrate the concept of magnetoresistance requisite for practical application explanation, the importance for using magnetoresistive sensors for hard disks reading heads. We started from the magnetoresistance concept accessible for college students. The teacher led the discussion for defining the concepts of magnetoresistance and giant magnetoresistance (GMR).

Hereinafter, we developed deeply each direction. First it will be explained the Hall Effect and the magnetoresistive Effect, then it will be approached GMR (giant magnetoresistance), concept needed a high level of comprehension. For underlining the theoretical model of study it has to specify all types of geometries used: CPP (current perpendicular to plane) and CIP (current in plane), then there are classified GMR types (multilayer GMR, spin valve GMR, GMR in magnetic granular alloys), the Mott's model describing that electrical conductivity is specified and also some mathematical relations accessible to the high school students. These concepts' displaying as graphic organizers furnish to involved students a bird's-eye view of the connections of the concepts, and for the

teacher the opportunity to integrate different active methods in the class such are: project based learning or cooperative learning and also the possibility of using some informatics tools.

4. Conclusions

A first conclusion out coming is that during constructivist learning layouts, when knowledge building is directed and controlled strictly by the teacher the students has a greater opportunity to achieve scientific knowledge than during a traditional rigged up one.

The second conclusion is that during constructivist learning layouts, students achieve more learning abilities for reality knowledge and it's describing than during the traditional rigged ones.

At least, but not at last we mentions the opportunity of integration in our lessons of some active learning methods allowing cooperation between students and teachers or using of some informatics tools or web 2.0 tools.

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